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Developmental Aspects of Delinquency and Internalizing Problems and Their Association With Persistent Juvenile Substance Use Between Ages 7 and 18

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Analyzed longitudinal data from 3 samples of the Pittsburgh Youth Study on boys ages 7 to 18 to examine the co-occurrence of persistent substance use with other problem behaviors, including attention deficit hyperactivity disorder (ADHD), persistent delinquency, and persistent internalizing problems (i.e., depressed mood, anxiety, shy or withdrawn behavior). In preadolescence, persistent substance users also tended to be persistent delinquents, and half of this group displayed persistent internalizing problems as well. In adolescence, a third of the persistent substance users did not manifest other persistent problems. Across the samples, the least common substance users were those who manifested persistent internalizing problems only. Logistic regression analyses showed that persistent substance use in preadolescence was predicted by persistent delinquency and internalizing problems and in adolescence by persistent delinquency only. The combination of persistent substance use and delinquency was predicted by oppositional defiant disorder in middle childhood and by persistent internalizing problems in middle to late childhood. ADHD was not a predictor of persistent substance use (and delinquency) in any of the analyses. Results are discussed in terms of developmental models of multiproblem youth with an eye on improving early interventions.

It is important to study persistent substance users in childhood and adolescence because a subset of this group is likely to become substance abusers. In addition, persistent substance users often display other persistent problem behaviors, such as attention deficit hyperactivity disorder (ADHD), delinquency and internalizing problems (i.e., depressed mood, anxiety, and shy or withdrawn behavior). In fact, eventually, multiple-problem youth manifest both externalizing and internalizing behavior problems in addition to excessive substance use; however, the development of this group

from childhood to adolescence has received scant attention in the literature (but see Elliott, Huizinga, & Menard, 1989; Fergusson, Horwood, & Lynskey, 1994; Loeber, Farrington, Stouthamer-Loeber, & Van Kammen, 1998; Magnusson & Bergman, 1988; Verhulst & van der Ende, 1992, 1993).

This study examined a typology of boys' persistent substance use across different combinations of persistent problems, including ADHD, delinquency, and internalizing problems. The study examined the extent to which associations among different problems vary with age and can account for an early onset type of multiple-problem youth.

Emergence of Several Problem Behaviors From Late Childhood Through Late Adolescence

The period from late childhood to late adolescence appears to be a crucial risk window for emergence of several persistent problem behaviors. This is the period in which initiation to alcohol, tobacco, marijuana, and psychedelic drug use is virtually completed (Kandel & Logan, 1984) and in which regular use of several substances is consolidated (Harrington, Fudge, Rutter,

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Points of view or opinions in this document are ours and do not necessarily represent the official position of OJJDP, the Department of Justice, NIMH, or NIDA.

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Pickles, & Hill, 1991). Regular substance use by a minority of youth can be a first step in their escalation toward substance abuse (Donovan & Jessor, 1983; Ellickson, Hays, & Bell, 1992). Turning to delinquency, the period from late childhood to late adolescence is also the time in which the onset of delinquency takes place, ranging from less serious acts such as shoplifting to more serious acts such as burglary and aggravated assault (Elliott et al., 1989; Loeber & Farrington, 1998). Some researchers have stressed that early individual differences in behavior problems emerge at this time, and that these problems, in a minority of juveniles, persist over decades (e.g., Moffitt, 1993; Patterson, 1982). For example, considerable support has been found for continuity of delinquency over time and that such continuity is stronger in some individuals (Farrington, 1991; Loeber & Dishion, 1983; Loeber & Farrington, 1998). The period between late childhood and late adolescence is also the prime time in which internalizing problems, such as depressed mood, first appear and become persistent in some (Angold et al., 1996; Russo & Beidel, 1994).

In contrast to the aforementioned problems, ADHD (American Psychiatric Association, 1994) has, by definition, an onset prior to age 7. The reason for including ADHD is that the overactive subtype of ADHD is characterized by impulsive behavior and the tendency for juveniles to engage in many different behaviors, including substance use. The impact of ADHD on other problem behaviors often extends for many subsequent years (Farrington, Loeber, & Van Kammen, 1990; Hinshaw, 1987).

Issues in the Identification of Youth With Problem Behavior

Identification of youth with problem behavior is best when such behavior is highly stable. However, many problem behaviors are episodic; they are present at one assessment but absent at the next (Lahey et al., 1995; Ollendick & King, 1994; Verhulst & van der Ende, 1992). Therefore, repeated measurements are needed to identify those youth who persist in their problem behavior.

Confluence of Different Persistent Problems

One of the challenges in the study of persistent problem behavior is to explain why some youths eventually exhibit more than one type of problem behavior and become multiple-problem youth. The concurrent and predictive association between substance use and delinquency (including aggression) has been well documented (e.g., Brook, Whiteman, & Finch, 1992; Huizinga & Jakob-Chien, 1998; Kandel, Simcha-

Fagan, & Davies, 1986; White, Brick, & Hansell, 1993). There is also substantial evidence that a proportion of those juveniles who engage in regular substance use also suffer from internalizing problems, such as depressed mood, anxiety, and shy and withdrawn behaviors (e.g., Aseltine, Gore, & Colten, 1998; Bukstein, Brent, & Kaminer, 1989; Clark, Jacob, & Mezzich, 1994; Ensminger, Brown, & Kellam, 1982; Fleming, Offord, & Boyle, 1989; Helzer & Przybeck 1988; Kandel, Raveis, & Davies, 1991; Kushner, Sher, & Beitman, 1990). Adult alcoholics have been classified into various typologies depending on age of onset, internalizing problems, and externalizing problems (e.g., Babor et al., 1992; Cloninger, Bohman, & Sigvardsson, 1981; Zucker, 1987), but these studies have been restricted to clinical samples and drug abusers' retrospective reports of their childhood and adolescent behavior problems. In contrast, classification for juvenile substance abuse on the basis of co-occurring problem behaviors, based on prospective data, has not been well developed (Weber, Graham, Hansen, Flay, & Johnson, 1989; White & Labouvie, 1994).

It is well accepted that a diagnosis of ADHD often precedes the onset of problems in several other domains of functioning, including substance use (Weiss & Hechtman, 1986) or depression (Jensen, Burke, & Garfinkel, 1988). The fact that different problem behaviors may develop in sequence does not necessarily mean that such behaviors are significantly related to each other, because their unfolding over time may occur by chance alone. For example, several studies show an association between ADHD and substance use in juveniles (e.g., Gittelman, Mannuzza, Shenker, & Bonagura, 1985; Loeber et al., 1998; Mannuzza et al., 1991). However, most other studies show that the relation between ADHD and substance use is either nonsignificant (e.g., Boyle et al., 1992; Loeber & Green, 1997) or disappears once conduct problems or delinquency are taken into account (e.g., Biederman et al., 1997; Bukstein et al., 1989; Lynskey & Fergusson, 1995; Taylor, Chadwick, Heptinstall, & Danckaerts, 1996; but see Molina, Smith, & Pelham, 1998).

In the concurrent results from the Pittsburgh Youth Study (Loeber et al., 1998), we found that, in logistic regressions, ADHD explained substance use in each of three age samples (approximately 7, 11, and 13). However, these analyses did not control for co-occurring delinquency. The second finding was that depressed mood was associated with substance use only for the youngest boys, whereas anxiety was associated with substance use in the middle sample but not in the oldest sample. Thus, internalizing problems appeared to be associated with substance use at a young age, which also has been found in the Woodlawn study on African American youths (Ensminger et al., 1982). They identified in elementary school a group of aggressive, withdrawn boys

who were at risk for later marijuana use (Ensminger et al., 1982). Also, Brook et al. (Brook, Whiteman, Finch, & Cohen, 1995) found that early aggression predicted depression, which in turn was related to later illicit drug use.

Developmental Models of Co-Occurring or Comorbid Conditions

Some researchers have advocated a dichotomous model of onset of serious delinquent behaviors (Moffitt, 1993; Patterson, Capaldi, & Bank, 1991). For example, Moffitt (1993) postulated a distinction between early, life-course persistent (showing "tenacious stability across time and in diverse circumstances," p. 685) and adolescence-limited delinquents (characterized by an onset and desistance of delinquency during adolescence). However, longitudinal studies with regularly repeated measurements indicate that onset of persistent serious forms of delinquency is not concentrated in early childhood but tends to emerge gradually until about age 14 to 15 (Loeber & Farrington, 1998). In general, studies show that the more serious the type of delinquency committed, the higher the severity level of substance use (Huizinga & Jakob-Chien, 1998). An unknown proportion of these persistent offenders are regular substance users. To explain emergence of *multiple-problem youth* (defined here as those exhibiting persistent substance use and persistent delinquency) we postulate that throughout childhood and adolescence, stable multiple-problem youth emerge, characterized by two or more of the following: persistent substance use, persistent serious delinquency, or persistent internalizing problems. Most serious offenders can be identified before age 14 (Loeber & Farrington, 1998), and we presume that this also applies to multiple-problem youth.

We distinguish four different groups of persistent substance users, who are differentiated depending on the presence and the age of onset of disruptive–delinquent behaviors and internalizing problems. We see that advances in classification can be made in at least two ways. First, a developmental classification that takes into account age of onset and course (i.e., the sequence of development) is justified given the relatively long risk window, with some individuals developing substance abuse at a precocious age and other individuals reaching the same condition much later (see Zucker, Ellis, Fitzgerald, Bingham, & Sanford, 1996). For example, Van Kammen, Loeber, and Stouthamer-Loeber (1991) found that, in the youngest sample of this study, the overlap between the secret use of substances and delinquency already occurred as early as the first grade. During late childhood through adolescence, substance use became more firmly intertwined with conduct problems and delinquency. Second, given the fact that delinquency and internalizing problems often co-occur in individuals who regularly use substances and given

that most behavior problems tend to increase in prevalence starting in adolescence, there is a need to incorporate these problems in a developmental model of substance abuse (Zucker et al., 1996).

We propose a tentative, heuristic model of four categories of persistent substance users in childhood and adolescence that can be mapped on a grid of age of onset against course:

1. *Mixed type*: Substance users with a history of persistent disruptive and delinquent behavior and with internalizing problems (mixed referring to the mixture of externalizing and internalizing problems). We hypothesize that this type already emerges during middle to late childhood.

2. *Internalizing type*: Persistent substance users without serious delinquency but with a history of internalizing problems. We hypothesize that this type is as common in late childhood as it is in adolescence.

3. *Delinquent type*: Persistent substance users who also engage in persistent serious delinquency but do not score high on internalizing problems. We hypothesize that this type becomes more common from late childhood to adolescence.

4. *Nondeviant type*: Substance users without a history of delinquency or internalizing problems who become regular users of certain substances. We hypothesize that this type is less prevalent in late childhood and becomes more common in adolescence.

We consider two versions of the four types: with and without ADHD. This article addresses the following questions:

1. Is the strength of association between delinquency and internalizing problems, on the one side, and substance use, on the other, stronger when measured repeatedly compared to concurrently?

2. Of all persistent substance users, are those with persistent delinquency and internalizing problems overrepresented among younger compared to older boys?

3. Is persistent substance use predicted by ADHD, delinquency, and internalizing problems, and do these predictions vary by age?

4. Are ADHD, oppositional defiant behavior, and persistent internalizing behavior implicated in the comorbid persistence of both substance use and delinquency? These questions are addressed using data from the Pittsburgh Youth Study.

Methods

Participants

The Pittsburgh Youth Study consists of three samples of boys who were in Grades 1, 4, and 7, respec-

tively, when the study began in 1987 and 1988 (called the youngest, middle, and oldest samples, respectively). Potential participants were randomly selected from the list of all boys in these grades in the Pittsburgh Public Schools. At the time of sample selection, 72% of all school children in Pittsburgh attended public schools. Of those selected, 84.8% of families consented to participate in the study, resulting in a sample of 850 boys in each of the three grades (for details, see Loeber et al., 1998). After an initial screening assessment (Wave S), a final sample for follow-up was selected, consisting of the 250 most antisocial youngsters in each grade, complemented by an equal number of boys randomly selected from the remainder. This resulted in three grade samples of about 500 boys who have been followed up, initially every half year and later annually. The average ages of the participants at the screening wave were 6.9, 10.2, and 13.4 for the youngest, middle, and oldest samples, respectively. The data presented here for the youngest sample from the screening and the following eight assessment waves are spaced at 6-month intervals (up to 1991, when the boys averaged 10.9 years old). Data used for the middle sample cover the screening and the six following assessment waves up to 1990 (when the participants averaged 13.3 years old; after which the middle sample was no longer assessed). The oldest-sample data were used from the screening and the seven following assessment waves (up to 1991, when they averaged 17.9 years old). The last two assessment waves were done at yearly intervals. About half of the boys were African American and half were Caucasian.

Participant retention has been high throughout this study. For the assessment waves used in this study, the participation rates averaged 96.1% (range: 93.6–100%), 96.8% (range: 93.9–100%), and 93.6% (range: 86.0–100%) for the youngest, middle, and oldest samples, respectively.

Measures

Caretaker. In the screening interview, we administered an expanded version of the Child Behavior Checklist (CBCL; Achenbach, 1978; Achenbach & Edelbrock, 1979, 1983; Loeber et al., 1998). This version of the CBCL is a 112-item questionnaire about a wide range of child behavior problems such as anxiety, depression, compulsions, oppositional behaviors, hyperactivity, and delinquency. The time frame for the Extended CBCL was the past 6 months. In the first follow-up, the caretakers were given the Diagnostic Interview Schedule for Children–Parent Version (DISC–P; Costello, Edelbrock, & Costello, 1985). The Diagnostic Interview Schedule of Children (DISC) was developed as a measure of child psychopathology to be administered by lay interviewers in epidemiological surveys. The DISC–P was revised by Costello (1987) to

cover most forms of child psychopathology contained in the *Diagnostic and Statistical Manual of Mental Disorders* (3rd ed. [DSM–III]; American Psychiatric Association, 1980); and *DSM–III–R* (3rd ed., rev.; American Psychiatric Association, 1987). Anxiety and relatively rare disorders such as psychosis were not covered in the interview.

Teacher. Teachers completed an extended version of the Teacher Report Form (TRF; Loeber et al., 1998) complementary to the CBCL (Edelbrock & Achenbach, 1984). The time frame for the TRF was 6 months, the same as for the caretaker CBCL.

Child. Boys in the oldest sample were administered the revised version of the National Youth Survey 40-item Self-Reported Delinquency Scale (SRD; Elliott, Huizinga, & Ageton, 1985). For each question, the boy was asked whether or not he had ever engaged in a behavior and how often he had done it in the past 6 months. We also administered to the boys in the oldest sample a 16-item Substance Use Scale based on the National Youth Survey, developed by Elliott and colleagues (Elliott et al., 1985), which has been evaluated extensively. For each substance use item, the participants were asked whether they had ever engaged in the behavior and if so, how often they had done it in the previous 6 months.

For boys in the youngest and middle samples, we did not initially use the SRD and the substance use scale because the questions were deemed to be age-inappropriate or too difficult to understand. Instead, a 33-item Self-Reported Antisocial Behavior Scale (SRA; Loeber, Stouthamer-Loeber, Van Kammen, & Farrington, 1989) was developed, in which age-inappropriate items such as joy-riding or low frequency items such as illegally using credit cards were eliminated. The SRA contained questions covering tobacco use and the use of beer, wine, liquor, and marijuana. Because of the age of the boys, we did not ask retrospective age of onset questions, just information about the past 6 months and lifetime. In addition, the frequency range was restricted to *once*, *twice*, and *more often*. Alcohol use was only counted if it occurred without parents' permission. Participants in the middle sample were switched from the SRA to the SRD and the substance use scale at the second assessment wave when they were about 10.5 years of age, whereas participants in the youngest sample were switched at a similar age occurring at the eighth assessment wave.

Constructs. Persistent drug use, persistent delinquency, and persistent internalizing problem constructs

were made by ranking participants within sample at each assessment wave. Depending on the availability of information, the ranking in each assessment wave was based on either frequency, severity, or variety (i.e., different types) of delinquent acts. *Persistence* refers to a ranking above the cutoff point in at least two waves, depending on the sample and behavior. Although our goal was to isolate the top 25% for each construct and sample, this was not always possible. For that reason, definition of *persistence* inevitably varied somewhat from a high deviant behavior score over at least two waves for some behaviors displayed by the youngest sample to a high deviant behavior score over at least four waves for the oldest sample. Our justification was that recurrence was much more atypical at a younger than at an older age.

Persistent substance use. We created a persistent substance use construct taking into account frequency, seriousness and number of waves noted.

For the oldest sample, at each of the eight assessments, the frequency for five seriousness levels of drug use were calculated (beer and wine, cigarettes, liquor, marijuana, and other drugs; Loeber et al., 1998). Alcohol use had to be without parents' permission, and other drugs had to be without a doctor's prescription. Frequencies were then combined by weighting the frequency of the lowest level of substance use (i.e., beer or wine by 1, etc., up to a weight of 5 for Level 5, i.e., other drugs.) Weighting allows the creation of a single substance use score combining scores on different substances according to their severity (as pointed out by Pandina, White, & Yorke, 1981). Each of these wave constructs were dichotomized so as to identify the 25% with the highest weighted frequency score. Participants were designated as persistent if they were classified in four or more waves out of eight as being in the top 25% (25.4%, $N = 116$).

For the middle sample, the cutoff by wave was between no use and any use and identified between 10.2% and 18.8% as substance users at each wave. To be classified as a persistent substance user in the middle sample, the participant had to have been above the cutoff in at least three waves (14.6%, $N = 71$).

For the youngest sample, the SRA provided only prevalence data for seriousness levels 1 through 4 for the first seven assessment waves. For the last two assessment waves, the substance use scale was used, providing frequency data and seriousness levels. The cutoff for each wave was between no use and any use. A participant had to be above the cutoff in at least two assessment waves (8.5%, $N = 43$).

Persistent delinquency. The persistent delinquency construct also combined seriousness, frequency, and number of waves. Three levels of seriousness were

used (Loeber et al., 1998). Minor delinquency included acts such as stealing something worth less than \$5, vandalism, and cheating somebody by selling something that was worth less than they said it was; moderate delinquency included theft over \$5, pickpocketing, fencing, and carrying a weapon; and serious delinquency included breaking and entering, car theft, robbery, and attacking to hurt or kill.

For the oldest sample, at each assessment the frequency for three levels of delinquency seriousness were calculated. The frequencies were then combined by weighting the frequency of the lowest level by 1, the frequency of the second level by 2, and that of the most serious delinquency level by 3. Each of these wave constructs were dichotomized so as to identify approximately 25% with the highest weighted frequency score. Participants were designated as persistent if they were classified in four or more waves (out of eight waves) as being in the top 25% (24.8%, $N = 112$).

For the middle sample, the same procedure as for the oldest sample was used except at the screening assessment. The delinquency variety score (number of different delinquent acts) was used because the participants were administered the SRA, which did not include a continuous frequency score. The cutoff point for delinquency persistence was for the participant to be in the top 25% for three or more times (out of seven times; 28.4%, $N = 136$).

For the youngest sample, the delinquency variety score was used for the first seven waves, whereas for the last two waves, when the SRD was administered, the frequency score for three levels of delinquency seriousness was used. At each wave, those participants scoring in the top 25% on the delinquency score were identified. To classify as a persister, participants had to be in the top 25% for four waves (out of nine waves; 29.4%, $N = 138$).

Persistent internalizing problems. The persistent internalizing construct was made from 27 questions in the CBCL and the TRF covering depression, shyness-withdrawal, and anxiety. An item was scored positive if either the caretaker or the teacher noted the behavior. The total scores by wave were dichotomized, isolating the top 20%. For all three samples, a participant had to have been placed in the top 20% at least three times out of nine, seven, and eight assessments for the youngest, middle, and oldest samples, respectively (youngest sample, 26.7%, $N = 131$; middle sample, 21.1%, $N = 107$; oldest sample, 23.3%, $N = 105$).

ADHD. This *DSM-III-R* diagnosis was based on the DISC-P administered to the caretaker at the second assessment wave. The diagnosis was established by 28 questions covering 14 behaviors. To qualify for a diag-

nosis of ADHD, a participant had to be rated positive on at least 8 of the 14 behaviors (for reliability of the diagnosis, see Hart, Lahey, Loeber, Applegate, & Frick, 1995). In the youngest sample, 86 participants qualified for a diagnosis (17.1%), whereas in the middle sample, 63 participants qualified for a diagnosis (12.4%), and the number in the oldest sample was 47 (9.3%).

Oppositional defiant disorder (ODD). This *DSM-III-R* diagnosis is used in a limited number of analyses as an indicator of early externalizing problems. It is based on the DISC-P, which required that at least five out of nine ODD behaviors were scored positively. For the purpose of these analyses, ODD was scored even if the participant qualified for conduct disorder. This yielded 41 (8.2%), 77 (15.2%), and 80 (15.8%) participants with ODD in the youngest, middle, and oldest samples, respectively. ODD tends to be quite stable over time (Cohen, Cohen, & Brook, 1993).

Analyses

The analyses consisted of prevalence, odds ratios (ORs), and logistic regression. ORs are presented because they express the strength of association between two behaviors, independent of their base rates. OR is calculated on the basis of a 2×2 interaction table and expresses the likelihood that the presence of one condition is associated with an increased likelihood of the presence of another condition. Usually, an OR of 2 is statistically significant and signifies that the likelihood of the other condition is twice as large when the first condition is present compared to its absence. Logistic regressions were done for each sample separately and were justified because of the dichotomous nature of the outcome (persistent problem behavior, yes or no). The order of entry of constructs in the logistic regression was not stipulated. Variables were allowed to enter the model if the p of the partial R was less than .10.

Results

We first compared the extent to which associations between problem behaviors improved when persistence was taken into account compared with their occurrence at a single wave (measured at the second wave). The association between substance use and delinquency was substantially stronger when persistence was taken into account compared to concurrently, and this increased with age (youngest sample: OR = 6.8 vs. 5.0; middle sample: OR = 7.8 vs. 4.1; oldest sample: OR = 11.3 vs. 6.6). Likewise, the association between substance use and internalizing problems reached statistical significance when persistence was taken into

account in two out of the three samples (youngest sample: OR = 2.1; middle sample: OR = 2.9) and was nonsignificant when concurrent data were used. In contrast, the concurrent association between substance use and ADHD was nonsignificant in all three samples and remained nonsignificant when persistence of substance use was taken into account. Thus, in five out of the nine comparisons, the association among persistent problem behaviors tended to be stronger compared to concurrent associations.

Table 1 shows that the proportion of persistent substance users with other persistent problems differed across the three age samples. In the youngest sample, the most prevalent types were the mixed type (persistent substance use with persistent delinquency and internalizing problems, with or without ADHD) and the delinquent type (persistent substance use with persistent delinquency but without internalizing problems), consisting of 34.9 and 34.9%, respectively, of all persistent substance users. The two types had persistent delinquency in common, showing the importance of this behavior's association with substance use at a young age. The two types were also the most common types in the middle sample (32.4 and 33.8%, respectively). However, the mixed type was about half as common in the oldest sample (17.3%), compared to the youngest and middle sample. In contrast, the delinquent type in the oldest sample (41.4%) was about as common as in the youngest and oldest samples. Thus, the mixed type of combined externalizing and internalizing problems associated with persistent substance use was most observed in preadolescent boys.

In comparison to the mixed and the delinquent types, the internalizing type was quite rare among all persistent substance users in each of the samples (7.0% in the youngest and middle samples and 5.2% in the oldest sample). This shows that when persistent internalizing problems occurred in persistent substance users, they rarely occurred in isolation but more commonly in conjunction with persistent delinquency (i.e., the mixed and the delinquent types). Finally, a quarter of the persistent substance users in the youngest sample (23.3%) qualified for the non-deviant type (manifesting persistent substance use, but no persistent delinquency or internalizing problems), which increased to a third (36.8%) in the oldest sample. Table 1 also shows the breakdown of each type as a function of the presence or absence of ADHD. In all three samples, prevalence of all types was not higher when ADHD co-occurred.

Table 1 does not reveal which conditions were significantly associated with persistent substance use and whether such conditions vary with age. To address this issue, we examined which combinations of persistent problems were significantly associated (see Table 2). Persistent substance use was most strongly related to persistent delinquency in all three samples

Note: ADHD = attention deficit hyperactivity disorder.

DEVELOPMENTAL ASPECTS OF DELIQUENCY

Table 2. *Strength of Association Between Persistent Problem Behaviors*

Combination of Persistent Conditions	Sample					
	Youngest		Middle		Oldest	
	OR	95% CI	OR	95% CI	OR	95% CI
Substance Use and Delinquency	6.8	3.4–13.5	7.8	4.4–13.6	11.3	6.8–18.7
Internalizing Problems	2.1	1.1–4.1	2.9	1.7–4.9	<i>ns</i>	
ADHD	<i>ns</i>		<i>ns</i>		<i>ns</i>	
Delinquency and Internalizing Problems	<i>ns</i>		3.2	2.0–5.0	1.8	1.1–3.0
ADHD	1.7	1.0–2.8	1.9	1.1–3.3	<i>ns</i>	

Note: OR = odds ratio; CI = confidence interval; ADHD = attention deficit hyperactivity disorder.

Table 3. *Logistic Regression Predicting Persistent Substance Use*

Predictors	Sample								
	Youngest			Middle			Oldest		
	Adjusted OR	95% CI	Partial <i>r</i>	Adjusted OR	95% CI	Partial <i>r</i>	Adjusted OR	95% CI	Partial <i>r</i>
Persistent Delinquency	6.6***	3.3–13.2	.33	6.8***	3.8–12.0	.35	12.2***	7.2–20.5	.43
ADHD	—	—	—	—	—	—	—	—	—
Persistent Internalizing Problems	1.9*	1.0–3.7	.08	2.0**	1.1–3.6	.10	—	—	—

Note: OR = odds ratio; CI = confidence interval; ADHD = attention deficit hyperactivity disorder.

p* < .10. *p* < .05. ****p* < .0001.

Table 4. *Logistic Regression Predicting Persistent Substance Use and Delinquency*

Predictors	Sample								
	Youngest			Middle			Oldest		
	Adjusted OR	95% CI	Partial <i>r</i>	Adjusted OR	95% CI	Partial <i>r</i>	Adjusted OR	95% CI	Partial <i>r</i>
ODD	3.7**	1.5–9.2	.16	—	—	—	3.9***	2.1–7.0	.22
ADHD	—	—	—	—	—	—	—	—	—
Persistent Internalizing Problems	2.4*	1.1–5.3	.12	3.9***	2.0–7.4	.22	—	—	—

Note: OR = odds ratio; CI = confidence interval; ODD = oppositional defiant disorder; ADHD = attention deficit hyperactivity disorder.

p* < .05. *p* < .01. ****p* < .001.

and increased in magnitude with age (ORs varied from 6.8 to 11.3). Persistent substance use was less strongly related to persistent internalizing problems in the youngest and middle samples only (OR = 2.1 and 2.9, respectively). In contrast, persistent substance use was not related to ADHD in all three samples; however, persistent delinquency was related to ADHD in the two younger samples (OR = 1.7 and 1.9, respectively). Also, persistent internalizing problems were significantly associated with ADHD in all three samples (ORs = 2.8–4.0). Finally, internalizing problems were significantly associated with delinquency in the middle and oldest samples only (OR = 3.2 and 1.8, respectively).

We next addressed how well persistent substance use could be predicted in a logistic regression by ADHD,

persistent delinquency, and internalizing problems and whether the prediction was better in late childhood compared to in adolescence. Table 3 presents the results for each sample. Note that ADHD, although nonsignificantly associated with substance use in the univariate analyses, was included in the logistic regression analyses to examine its relation to the other predictors. Results show that in the youngest and middle samples, persistent substance use was significantly predicted by persistent delinquency and persistent internalizing problems (the latter at a marginally significant level for the youngest sample). In contrast, persistent substance use in the oldest sample was significantly predicted by persistent delinquency only. For all three samples, persistent delinquency was the strongest predictor. ORs between persistent delinquency and persistent substance

use were twice as large for the oldest, compared to the youngest or middle samples (OR = 12.2 vs. 6.6 and 6.8). Results for the youngest sample also show that the OR for delinquency was stronger than that for internalizing problems (OR = 6.8 vs. 1.9), which also applied to the middle sample (OR = 6.8 vs. 2.0). In addition, Table 3 shows that, for all three samples, ADHD did not contribute to the prediction of persistent substance use when persistent delinquency and internalizing problems had been taken into account. Finally, none of the interaction terms (e.g., delinquency and internalizing problems) reached statistical significance.

Because results might have been influenced by the presence of earlier disruptive behavior, we repeated the analyses with ODD (measured at the second assessment) as one of the predictors. The introduction of ODD in the logistic regressions only slightly affected the configuration of results (not shown in Table 3; see Table 4). ODD predicted persistent substance use in the youngest sample only (OR = 3.2) and eliminated the effect of persistent internalizing problems found in the regression analyses without ODD in that sample. The logistic regression results remained identical for the middle and oldest sample.

Discussion

These results confirmed the importance of delinquency in its association with persistent substance use and disconfirmed that ADHD was implicated in the persistence of substance use. In addition, the study failed to find a relation between ADHD and persistent substance use with co-occurring persistent delinquency. These findings were replicated across the three age samples. In these respects, the study concurs with a majority of other studies showing a lack of association between ADHD and different measures of substance use (e.g., Biederman et al., 1997; Boyle et al., 1992).

Persistent substance use had the strongest relation with persistent delinquency. We are cautious about this link because a proportion of delinquent acts by juveniles are directly connected to substance use, including theft of money or goods to purchase alcohol or drugs, drug dealing, and the use of substances prior to the commission of delinquent acts (White, 1990).

Taking persistent substance use as a starting point, we found different configurations of co-occurring problems during middle to late childhood as compared to during adolescence. In preadolescence, the most common type of persistent substance user also showed persistent delinquency, and half of this group displayed persistent internalizing problems as well. In adolescence, a third of the persistent substance users did not manifest other persistent problems. Across the samples, the least common substance users were those who

manifested persistent internalizing problems only. This typological approach, using longitudinal data, is an attempt to better grasp which co-occurring problem behaviors are significantly related to the persistence of substance use.

The logistic regression results further lend support to the aforementioned conclusions, especially the association between persistent substance use and internalizing problems, particularly before adolescence. This finding supports two notions. First, *mood dysregulation* (expressed as depressive mood, anxiety, or shy or withdrawn behavior) may affect substance consumption, perhaps through self-medication (Weiss, 1992; although the reverse cannot be excluded). Second, the joint occurrence of emotional dysregulation and behavioral dysregulation often emerge at a young age, reflecting the early development of multiple-problem youth, who often display persistent substance use, delinquency, and internalizing problems (Loeber et al., 1998).

The study had a number of limitations. First, the study was restricted to boys, and we do not assume that the results apply to girls. Second, the study definitions of persistency of problem behavior were restricted by the number of data waves available for analyses, which were not exactly the same number for all samples. Third, the definitions of problem behavior at a given wave were dependent on types of measures used and availability of indicators of prevalence, variety, frequency, or severity of the problem behavior. Some measures, such as those for substance use, inevitably were simpler for younger boys compared to those for older boys. The principle, however, that tied different measures together was the notion that individuals who ranked highest on a given measure at one time would tend to rank highest on another measure taken at a different time even though absolute levels of deviance might vary (Farrington, 1997). It should also be understood that substance use for preadolescent boys rarely included marijuana use or other drug use that became more common among older boys (Loeber et al., 1998). What this study did not aim to address is the temporal relation between different types of substance use and different types of delinquency (see, e.g., Huizinga, Menard, & Elliott, 1989; White, Loeber, Stouthamer-Loeber, & Farrington, 1998). Finally, the broad associations found in this study may very well represent the influence of many other factors not incorporated in these analyses, including psychosocial processes such as parents' childrearing practices and modeling of substance use, peer influences, and pharmacological effects of substance use. On the more positive side, the focus of this article on persistence of substance use in the context of the persistence of other problem behavior constitutes a steppingstone toward the formulation of better developmental models explaining the evolution of multiple-problem boys, particularly at an early age. Such models will, by necessity, force us to reexamine

how interventions can be improved for this seriously affected group of youth.

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